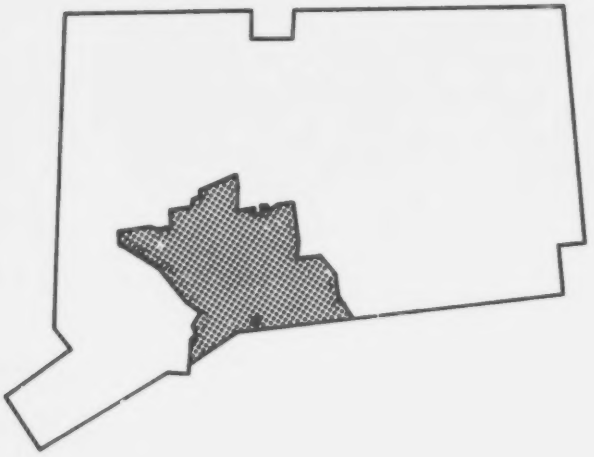
DEC 6 1990

FLOOD INSURANCE STUDY

TOWN OF EAST HAVEN, CONNECTICUT
NEW HAVEN COUNTY



REVISED
JANUARY 17, 1991

Federal Emergency Management Agency

COMMUNITY NUMBER - 090076

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: February 1, 1978

Flood Insurance Study Revised: September 16, 1982 (Flood Insurance Rate Map dated March 16, 1983)
January 17, 1991

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	2
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	4
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
	3.1 Hydrologic Analyses	5
	3.2 Hydraulic Analyses	8
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	13
	4.1 Flood Boundaries	13
	4.2 Floodways	15
5.0	INSURANCE APPLICATION	16
	5.1 Reach Determinations	16
	5.2 Flood Hazard Factors	23
	5.3 Flood Insurance Zones	23
	5.4 Flood Insurance Rate Map Description	24
6.0	OTHER STUDIES	24

TABLE OF CONTENTS - continued

	Page
7.0 LOCATION OF DATA	25
8.0 BIBLIOGRAPHY AND REFERENCES	25

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Frequency-Discharge, Drainage Area Curves	6, 7
Figure 3 - Transect Location Map	11
Figure 4 - Typical Transect Schematic	14
Figure 5 - Floodway Schematic	21

TABLES

Table 1 - Summary of Stillwater Elevations	8
Table 2 - Transect Descriptions	10, 12
Table 3 - Floodway Data	17 - 20
Table 4 - Flood Insurance Zone Data	22
Table 4A - Flood Insurance Zone Data	23

EXHIBITS

Exhibit 1 - Flood Profiles

Farm River (East Haven River)	Panels 01P - 07P
Maloney Brook	Panel 08P
Tuttle Brook	Panels 09P - 10P

Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWN OF EAST HAVEN, CONNECTICUT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of East Haven, New Haven County, Connecticut, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the original study were prepared by the Soil Conservation Service (SCS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-9-76, Project Order No. 1. That work was completed in January 1977.

In 1981, this study was revised to include the effects of wave action as recommended by the National Academy of Sciences. This work, which was completed in September 1981, was performed by Dewberry & Davis, for FEMA, under Contract No. EMW-C-0543.

This revision to incorporate the effects of potential erosion of the sandy shorelines in the Town of East Haven was prepared by Dewberry & Davis, for FEMA, under Contract No. EMW-89-C-2906, and was completed in January 1990.

1.3 Coordination

In March and December 1975, meetings covering the riverine portion of this study were held at the East Haven Town Hall to select the community base map and to identify streams requiring detailed study.

The New England Division of the U. S. Army Corps of Engineers (COE) and Griswold and Fuss, Inc., were contacted to obtain available flood data pertaining to the study area.

During the course of the riverine study, flood elevations, floodplain boundaries, and floodway delineations were reviewed with community officials. On December 2, 1976, the results of this study were reviewed at a final Consultation and Coordination Officer's (CCO) meeting held at the East Haven Middle School and attended by representatives of the Soil Conservation Service (SCS), FEMA, and residents and officials of the town.

In 1981, a restudy was performed to include a wave height analysis. For that restudy, the Aero Graphics Corporation of Bohemia, New York, the Connecticut Departments of Transportation and Public Works, and the Town of East Haven were contacted to obtain information. The results of that restudy were reviewed at another final CCO meeting on October 27, 1981, attended by representatives of FEMA, the town, and Dewberry & Davis (the study contractor).

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of East Haven, New Haven County, Connecticut. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods for their entire lengths within the community: the Farm River (East Haven River), Maloney Brook, Tuttle Brook, and Morris Creek. Also studied by detailed methods was tidal flooding including wave action from Long Island Sound. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

A portion of Tuttle Brook was studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Town of East Haven.

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT

(NEW HAVEN CO.)

APPROXIMATE SCALE

4 0 4 8 1 MILE

VICINITY MAP

2.2 Community Description

The Town of East Haven is located in the middle of the coastline of Connecticut bordering Long Island Sound. It is bordered by the City of New Haven to the west, the Town of Branford to the east, the Town of North Haven to the northwest, and the Town of North Branford to the northeast. Long Island Sound forms the southern corporate limits of the town.

Commercial areas are primarily located along Interstate Route 95, which runs from east to west across the center of town. East Haven is located in the prevailing westerlies zone that often includes cyclonic disturbances that cross the country from the west or southwest. It is also exposed to occasional coastal storms, some of tropical origin, that travel northward along the Atlantic seaboard. In late summer and autumn, these storms occasionally attain hurricane intensity.

The topography from Interstate Route 95 to the south is relatively low and flat, whereas north of Interstate Route 95 the ridges and valleys are very pronounced. East Haven contains deep, loamy soils in the flat areas and shallow to bedrock soils along the ridges. The most visible ridges form the divide on each side of the long and narrow Farm River (East Haven River) Watershed. Even though the Farm River (East Haven River) is flanked by rough topography, the stream channel has a very mild slope. Tuttle Brook and Morris Creek, located in the flat southern portion of the town, have very mild channel slopes.

Tuttle Brook flows south from Interstate Route 95 to the airport, and then travels through the City of New Haven for 6,300 feet before re-entering southeastern East Haven as Morris Creek. It then empties into Long Island Sound. The Farm River (East Haven River) flows south through eastern East Haven, and into Long Island Sound. Below Interstate Route 95, the Farm River (East Haven River) forms the boundary between East Haven and the Town of Branford. Maloney Creek flows from the north-central portion of town into the Farm River (East Haven River). Development in the floodplain areas varies within the town.

2.3 Principal Flood Problems

Areas adjacent to the Farm River (East Haven River), Maloney Creek, Morris Creek, and Tuttle Brook are subject to periodic flooding due to the restricted floodplains or the storm tides from Long Island Sound. The most severe flooding in the past has been the result of rainfall from hurricanes. The flooding events that had the most effect on East Haven occurred in 1815, 1938, 1944, 1954, 1955, and 1960. The flood of record was in 1955; it had a recurrence interval of 50 years.

2.4 Flood Protection Measures

There are several privately owned coastal bulkheads along the shoreline of East Point that provide minimum flood protection.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

Synthetic rainfall-runoff methods, taken from SCS TR-20 were used for all of the streams to obtain the 10-, 50-, 100-, and 500-year peak discharges (Reference 1). The peak discharges for the selected frequencies for streams studied by detailed methods are shown in Figure 2.

Storm stillwater elevations used in this analysis were developed by Dewberry & Davis (Reference 2). These elevations were developed by adjusting the elevations published by the COE, using analysis of the New London, Connecticut tidal gage that was performed during the preparation of the Flood Insurance Study for the City of New London and using the profiles for the 1938 and 1954 storm events (References 3 and 4).

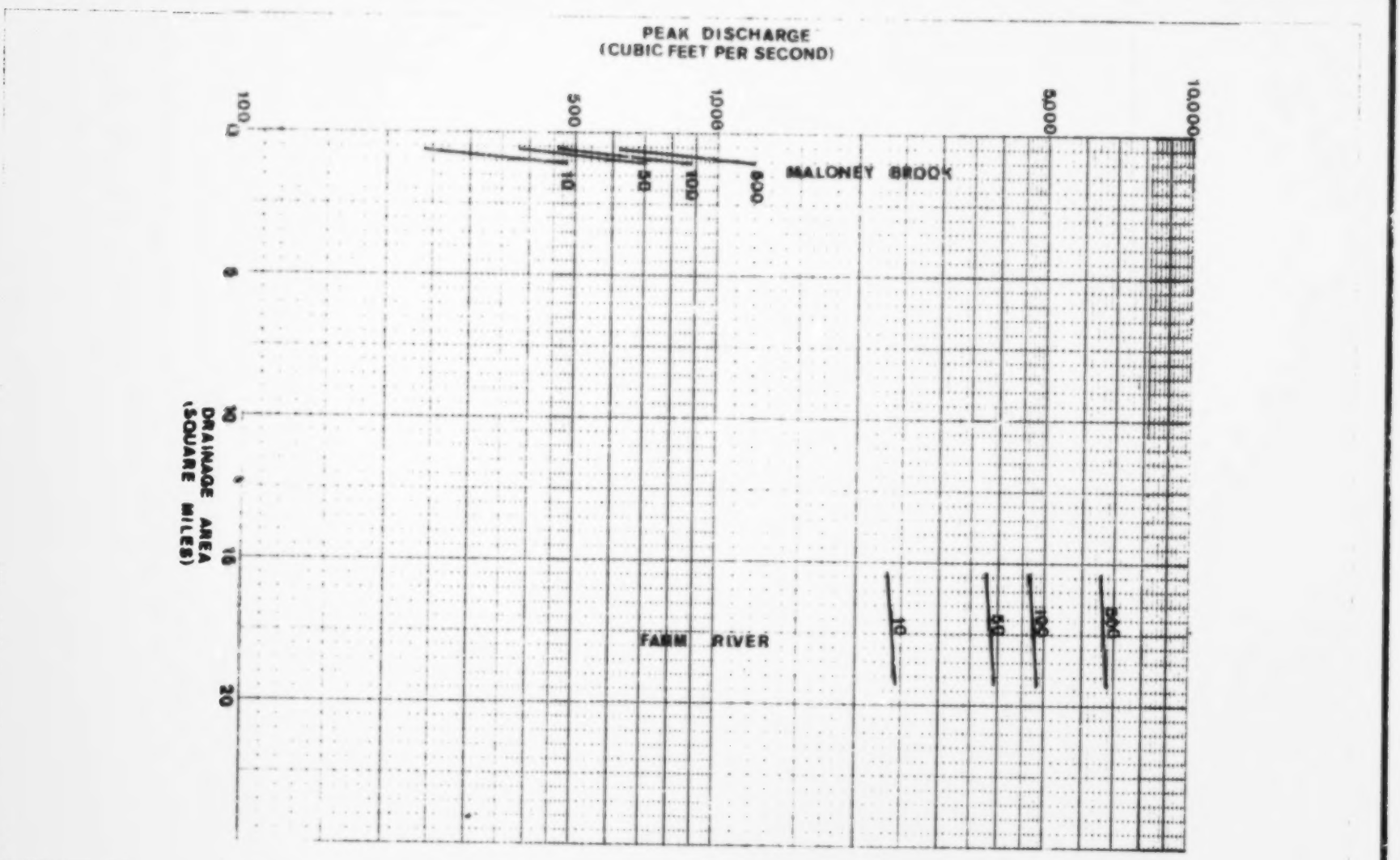


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

FREQUENCY DISCHARGE, DRAINAGE AREA CURVES

FARM RIVER-MALONEY BROOK

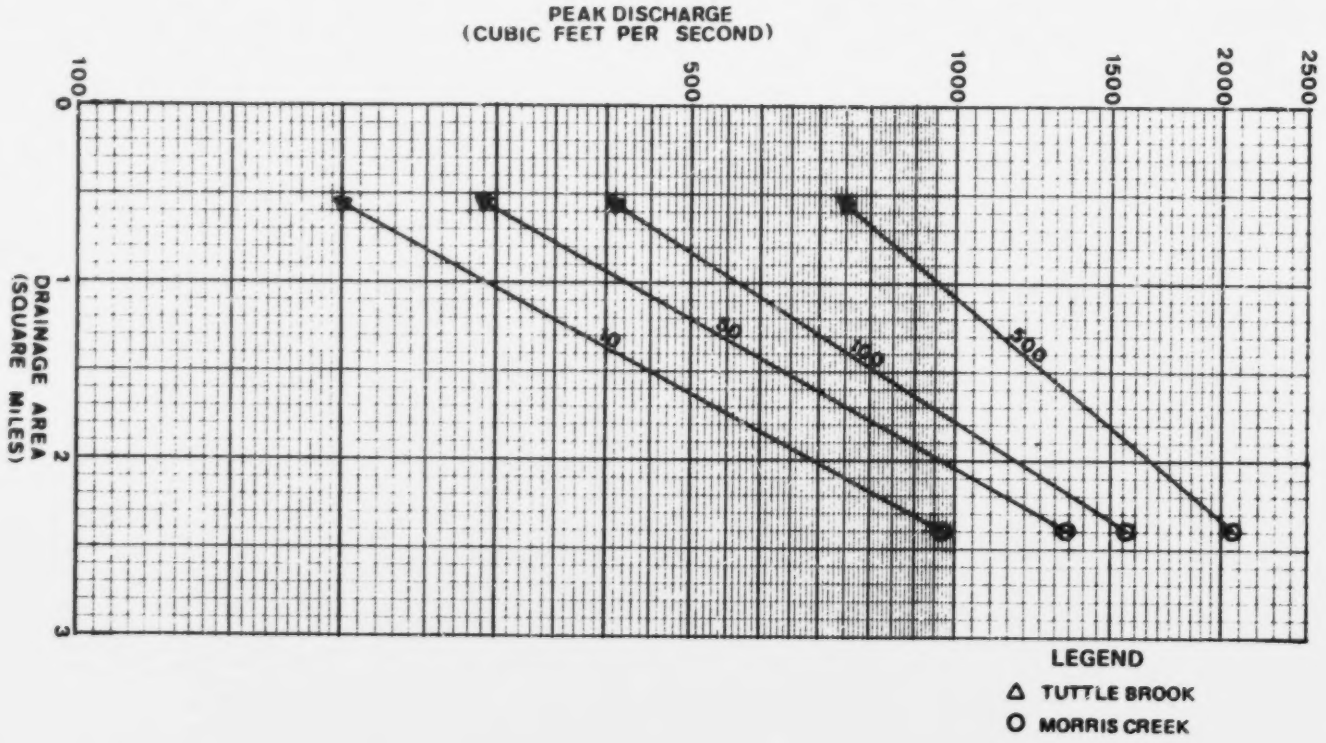


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

FREQUENCY DISCHARGE, DRAINAGE AREA CURVES

MORRIS CREEK-TUTTLE BROOK

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Long Island Sound and are summarized in Table 1, "Summary of Stillwater Elevations."

TABLE 1 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LONG ISLAND SOUND				
Entire shoreline within community	8.5	9.9	10.7	12.4

The analyses reported in this study reflect the stillwater elevations due to tidal and wind setup effects. The effects of wave action were also considered in the determination of flood hazard areas. Wave heights and corresponding wave crest elevations were determined using the National Academy of Sciences (NAS) methodology (Reference 5).

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

On the Farm River (East Haven River) below Interstate Route 95, Morris Creek, Tuttle Brook, and Maloney Creek, cross section data were obtained from field surveys. Bridges and culverts within the community were field surveyed to obtain elevation data and structural geometry. Cross section data for the Farm River (East Haven River) above Interstate Route 95 were obtained from a Connecticut Department of Environmental Protection report (Reference 6).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations for the streams studied by detailed methods were computed using the SCS WSP-2 step-backwater computer program (Reference 7). Flood elevations in the areas on Tuttle Brook above the Connecticut Turnpike were determined using a starting elevation at the Long Island Sound 10-year flood tide. The beginning portions

of the flood profiles for the Farm River (East Haven River), Tuttle Brook, and the entire portion of Morris Creek reflect the influence of the Long Island Sound and are not shown. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n") used in the hydraulic computations were estimated by field inspection at each cross section. The "n" values ranged from 0.035 to 0.085 for the streams studied by detailed methods.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

Coastal high hazard areas are areas of special flood hazards along the open coast that, at a minimum, include primary frontal dunes. During major storms, these dunes receive the full impact of the wave attack and respond in a sacrificial manner; the wave energy spent eroding the dunes will often reduce the wave damage inland. Because of their vulnerability to wave attack and their role as the frontline defense against storms, primary frontal dunes are designated as coastal high hazard areas. Other areas of coastline subject to high velocity wave action are also coastal high hazard areas. The COE has established the 3-foot breaking wave as the criterion for identifying these coastal high hazard areas (Reference 8). The 3-foot wave was determined to be the minimum size wave capable of causing significant damage to conventional wood frame or brick veneer structures.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the NAS report (Reference 5). This method is based on three major concepts. First, depth-limited waves in shallow water reach a maximum breaking height equal to 0.78 times the stillwater depth, and the wave crest is 70 percent of the total wave height above the stillwater level. Second, the wave height may be diminished by dissipation of energy due to the presence of obstructions such as sand dunes, dikes, seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction. Third, wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

These concepts and equations were used to compute wave crest elevations associated with the 100-year storm surge. Accurate topographic, land-use, and land cover data are required for the coastal analyses. The land-use and land cover data were obtained from aerial photographs (Reference 9). The topographic data were obtained from the following maps: U. S. Geological Survey (USGS) quadrangles of New Haven, Branford, and Woodmont; detailed topographic maps of the Town of East Haven at a scale of 1:1,200 with a contour interval of 2 feet; Colony Beach and Tennis Club Grading Plans at a scale of 1:480 with a contour interval of 2 feet; Colony Beach and Tennis Club Profiles with a horizontal scale of 1:1,200 and a vertical scale of 1:60; and beach topography at a scale of 1:480 (References 10, 11, 12, 13, 14, and 15).

Wave heights were computed along transects that were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Table 2, "Transect Descriptions," provides a listing of the transect locations and stillwater elevations, as well as the maximum wave crest elevations. Figure 3, "Transect Location Map," illustrates the location of the transects for the community.

TABLE 2 - TRANSECT DESCRIPTIONS

Transect	Location	Elevation (Feet NGVD) Stillwater 100-year	Maximum Wave Elevation[1] 100-Year
No. 1	Western corporate limits to a point approximately 200 feet east of town highway extended and from a point approximately 100 feet west of South End Road extended to Hampton Road extended	10.7	16
No. 2	A point approximately 200 feet east of town highway extended to a point approximately 100 feet west of South End Road extended (reflects all bulkheads)	10.7	16

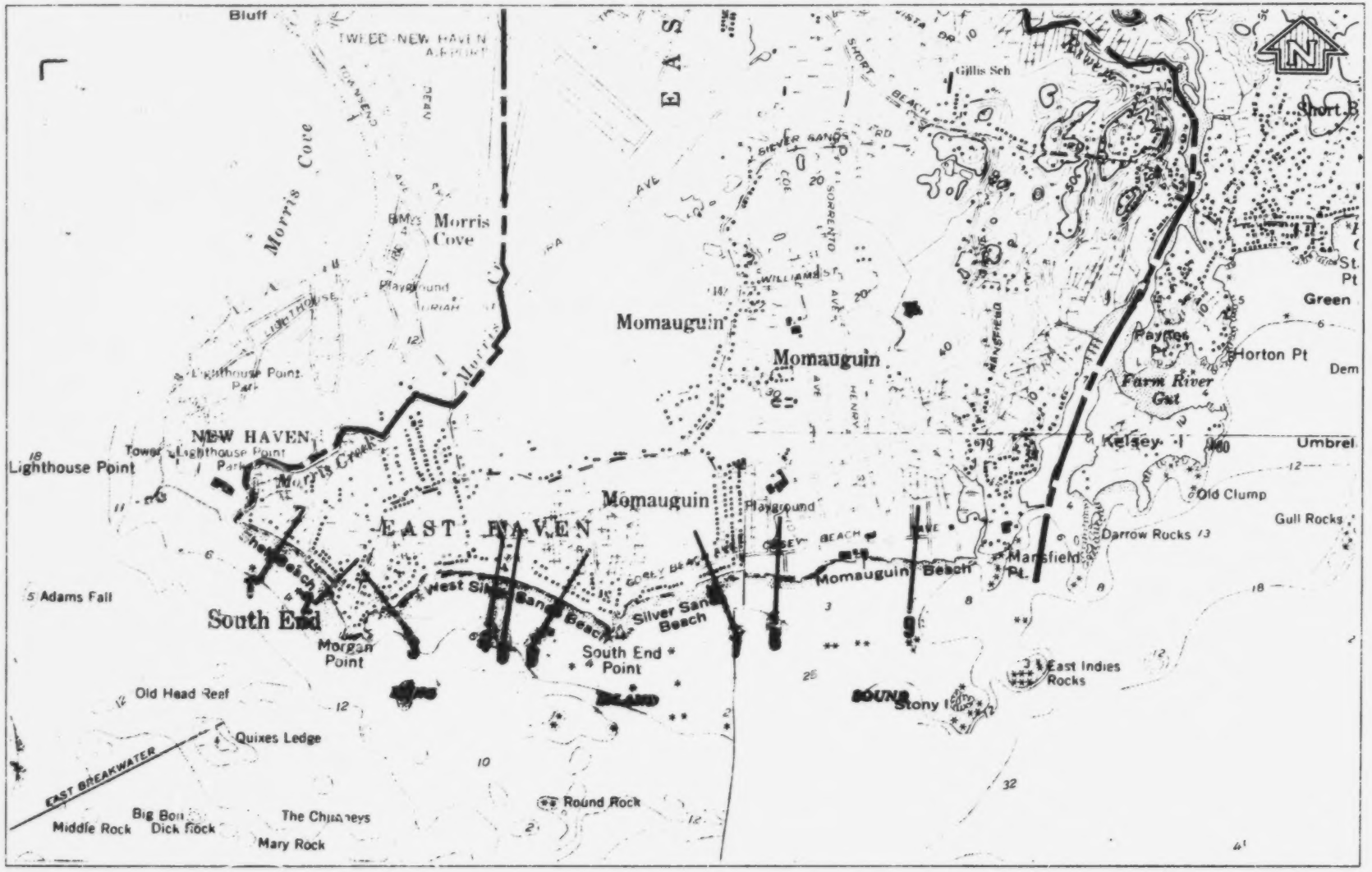


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

TRANSECT LOCATION MAP

TABLE 2 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (Feet NGVD) Stillwater 100-year	Maximum Wave Elevation[1] 100-Year
No. 3	Hampton Road extended to a point approximately 100 feet west of Pequot Street extended	10.7	16
No. 4	Approximately 100 feet west of Pequot Street extended to Minor Road extended	10.7	16
No. 5	Minor Road extended to a point approximately 300 feet west of Fairview Road extended	10.7	16
No. 6	From a point approximately 300 feet west of Fairview Road extended to a point approximately 900 feet west of Marion Road extended	10.7	16
No. 7	From a point approximately 900 feet west of Marion Road extended to Palmetto Trail extended	10.7	16
No. 8	Palmetto Trail extended to Henry Street extended	10.7	16
No. 9	Henry Street extended to eastern corporate limits	10.7	16

[1] Due to map scale limitations, the maximum wave crest elevation may not be shown on the FIRM

The topographic and bathymetric data used for the transects were adjusted in consideration of the potential for storm-induced dune erosion. Primary frontal dunes were evaluated for effectiveness as barriers to storm surge flooding and wave action. Dunes determined to be not effective were assumed to be completely eroded and removed from the transect. Dunes of sufficient size to be considered effective barriers during the 100-year event were assumed to be partially eroded, and a retreated dune profile shown on the transect.

Along each transect, wave envelope elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Between transects, elevations were interpolated using the topographic maps, land-use and land cover data, and engineering judgment to determine the areal extent of flooding. The results of these calculations are accurate until local topography, vegetation, or cultural development within the community undergo any major changes.

Figure 4 is a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland. This figure shows the wave elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Actual wave conditions in the Town of East Haven may not include all the situations illustrated in Figure 4.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year floodplain boundaries have been delineated using topographic maps (Reference 16).

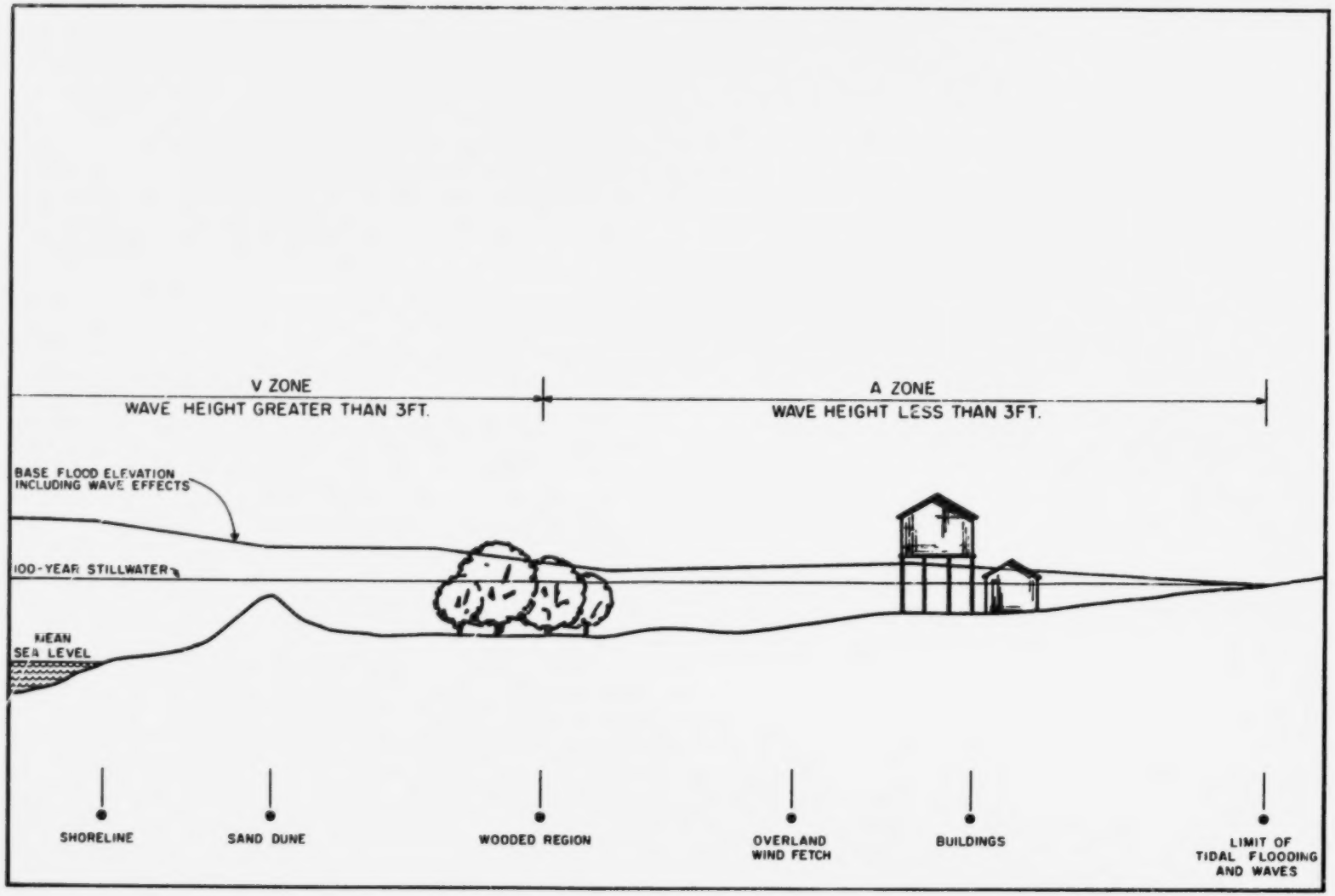


FIGURE 4
TYPICAL TRANSECT SCHEMATIC

For tidal areas without wave action, the 100- and 500-year floodplain boundaries were delineated using topographic maps at a scale of 1:24,000 with contour intervals of 10 and 20 feet (Reference 10). For the tidal areas with wave action, the flood boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using engineering judgment, land-cover data, and the topographic maps referenced above. The 100-year floodplain was divided into whole-foot elevation zones based on the average wave envelope elevation in that zone. Where the map scale did not permit these zones to be delineated at one foot intervals, larger increments were used.

For the flooding source studied by approximate methods, the 100-year floodplain boundaries were delineated using the previously printed Flood Insurance Study for the Town of East Haven (Reference 17).

The 100- and 500-year floodplain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

A floodway generally is not appropriate in areas such as those that may be inundated by floodwaters from Long Island Sound. Thus, no floodway was computed for the lower reaches of the Farm River (East Haven River), Morris Creek, and Tuttle Brook where flooding results from high levels of Long Island Sound rather than from high streamflow.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 5.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the Town of East Haven.

5.1 Reach Determinations

Reaches are defined as sections of floodplain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
FARM RIVER (East Haven River)							
A	16,004	97	895	3.44	15.5	14.5	1.0
B	16,393	86	851	3.62	15.7	14.7	1.0
C	16,521	70	772	3.99	15.9	14.9	1.0
D	16,871	220	2,208	1.39	16.3	15.3	1.0
E	17,223	470	2,596	1.18	16.3	15.3	1.0
F	17,535	343	2,554	1.20	16.5	15.5	1.0
G	18,092	61	521	5.91	17.7	16.7	1.0
H	18,526	92	830	3.71	18.4	17.4	1.0
I	18,705	424	5,106	0.60	21.3	20.3	1.0
J	19,304	674	7,636	0.63	23.1	22.1	1.0
K	20,354	582	5,777	0.84	23.1	22.1	1.0
L	20,614	505	3,324	1.46	23.1	22.1	1.0
M	21,654	767	7,777	0.62	23.2	22.2	1.0
N	21,919	539	5,889	0.82	23.3	22.3	1.0
O	23,199	646	5,869	0.83	23.3	22.3	1.0
P	23,659	375	3,866	1.26	23.3	22.3	1.0
Q	23,859	584	5,077	0.96	23.4	22.4	1.0
R	24,049	637	5,491	0.88	23.5	22.5	1.0
S	24,299	311	3,159	1.54	23.7	22.7	1.0
T	24,539	302	2,808	1.73	23.7	22.7	1.0
U	24,749	370	3,263	1.49	24.0	23.0	1.0
V	25,539	428	3,869	1.26	24.0	23.0	1.0
W	25,959	506	4,981	1.00	24.0	23.0	1.0
X	26,289	344	2,598	1.87	24.3	23.3	1.0
Y	27,039	483	3,435	1.42	24.5	23.5	1.0
Z	27,534	374	2,539	1.92	24.8	23.8	1.0

[1] Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT

(NEW HAVEN CO.)

FLOODWAY DATA

FARM RIVER (EAST HAVEN RIVER)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
FARM RIVER (East Haven River) (continued)							
AA	27,709	240	1,916	2.54	25.2	24.2	1.0
AB	28,489	467	2,623	1.86	25.6	24.6	1.0
AC	29,689	406	3,322	1.47	26.0	25.0	1.0
AD	30,809	157	1,264	3.86	26.9	25.9	1.0
AE	31,019	142	1,230	3.98	28.6	27.6	1.0
AF	31,769	572	3,116	1.57	29.1	28.1	1.0
AG	31,989	506	2,891	1.69	29.3	28.3	1.0
AH	32,749	720	5,885	0.83	29.4	28.4	1.0
AI	34,109	378	2,424	2.02	30.1	29.1	1.0
AJ	34,589	341	2,273	2.16	30.2	29.2	1.0
AK	34,899	454	2,667	1.84	34.9	33.9	1.0
AL	35,319	203	1,645	2.99	35.1	34.1	1.0
AM	35,754	189	1,282	3.75	36.4	35.4	1.0
AN	36,194	473	4,379	1.10	36.6	35.6	1.0
AO	36,504	615	5,633	0.85	36.8	35.8	1.0
AP	37,499	460	3,904	1.23	36.9	35.9	1.0
AQ	38,369	211	1,553	3.09	37.4	36.4	1.0
AR	39,133	265	1,834	2.59	39.6	38.6	1.0
AS	39,548	161	1,292	3.68	40.0	39.0	1.0
AT	40,103	227	1,957	2.43	40.5	39.5	1.0
AU	41,003	160	1,431	3.32	41.3	40.3	1.0
AV	41,442	137	1,277	3.71	41.8	40.8	1.0
AW	41,682	174	1,456	3.25	42.2	41.2	1.0
AX	41,799	248	2,184	2.16	42.3	41.3	1.0
AY	42,292	580	4,552	1.04	42.4	41.4	1.0

[1] Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

FLOODWAY DATA

FARM RIVER (EAST HAVEN RIVER)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
FARM RIVER (East Haven River) (Continued)							
AZ	42,616	403	2,210	2.13	43.6	42.6	1.0
BA	43,146	428	2,261	2.08	44.1	43.1	1.0
BB	43,806	758	5,021	0.93	44.2	43.2	1.0
BC	44,186	800	4,720	0.99	44.2	43.2	1.0
BD	44,323	917	5,257	0.89	44.2	43.2	1.0
BE	44,873	226	1,519	3.08	44.6	43.6	1.0
BF	45,753	335	2,137	2.18	45.6	44.6	1.0
MALONEY BROOK							
A	395	121	1,007	0.86	36.7	35.7	1.0
B	1,372	26	91	7.39	43.7	43.2	0.5
C	1,530	130	1,248	0.52	53.4	52.4	1.0
D	2,596	75	408	1.47	53.6	52.6	1.0
E	2,750	101	156	3.86	53.8	52.8	1.0
F	2,929	24	82	7.18	54.6	54.1	0.5
G	3,095	28	122	4.42	58.3	57.8	0.5
H	3,954	41	100	4.68	67.7	66.7	1.0

[1]Feet Above Mouth

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

FLOODWAY DATA

FARM RIVER (EAST HAVEN RIVER)-MALONEY BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
TUTTLE BROOK							
A	15,494	72	348	2.81	12.5	11.5[2]	1.0
B	15,622	22	113	8.58	12.5	11.5[2]	1.0
C	16,748	110	308	2.43	15.2	14.2	1.0
D	16,903	124	701	1.06	15.4	14.4	1.0
E	17,102	64	342	2.17	15.4	14.4	1.0
F	17,668	400	2,031	0.35	15.8	14.8	1.0
G	18,012	181	479	1.44	15.8	14.8	1.0
H	18,093	196	512	1.29	15.9	14.9	1.0
I	18,341	67	365	1.78	15.9	14.9	1.0
J	18,654	169	883	0.71	17.5	16.5	1.0
K	18,967	155	913	0.68	17.5	16.5	1.0
L	19,559	23	152	3.09	17.6	16.6	1.0
M	19,917	22	109	3.75	18.1	17.1	1.0

[1]Feet Above Mouth [2]Does Not Consider Tidal Influence

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT

(NEW HAVEN CO.)

FLOODWAY DATA

TUTTLE BROOK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
FARM RIVER (East Haven River)							
Reach 1	0002	-3.0	-1.1	3.2	030	A6	Varies - See Map
Reach 2	0001,0002	-4.5	-1.5	3.1	045	A9	Varies - See Map
Reach 3	0001	-2.8	-1.1	2.5	030	A6	Varies - See Map
Reach 4	0001	-1.9	-0.6	1.0	020	A4	Varies - See Map
MALONEY BROOK							
Reach 1	0001	-0.8	-0.4	0.4	010	A2	Varies - See Map
Reach 2	0001	-2.3	-0.5	0.8	025	A5	Varies - See Map
Reach 3	0001	-0.6	-0.2	0.3	005	A1	Varies - See Map
TUTTLE BROOK							
Reach 1	0002	-0.7	-0.4	1.2	005	A1	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

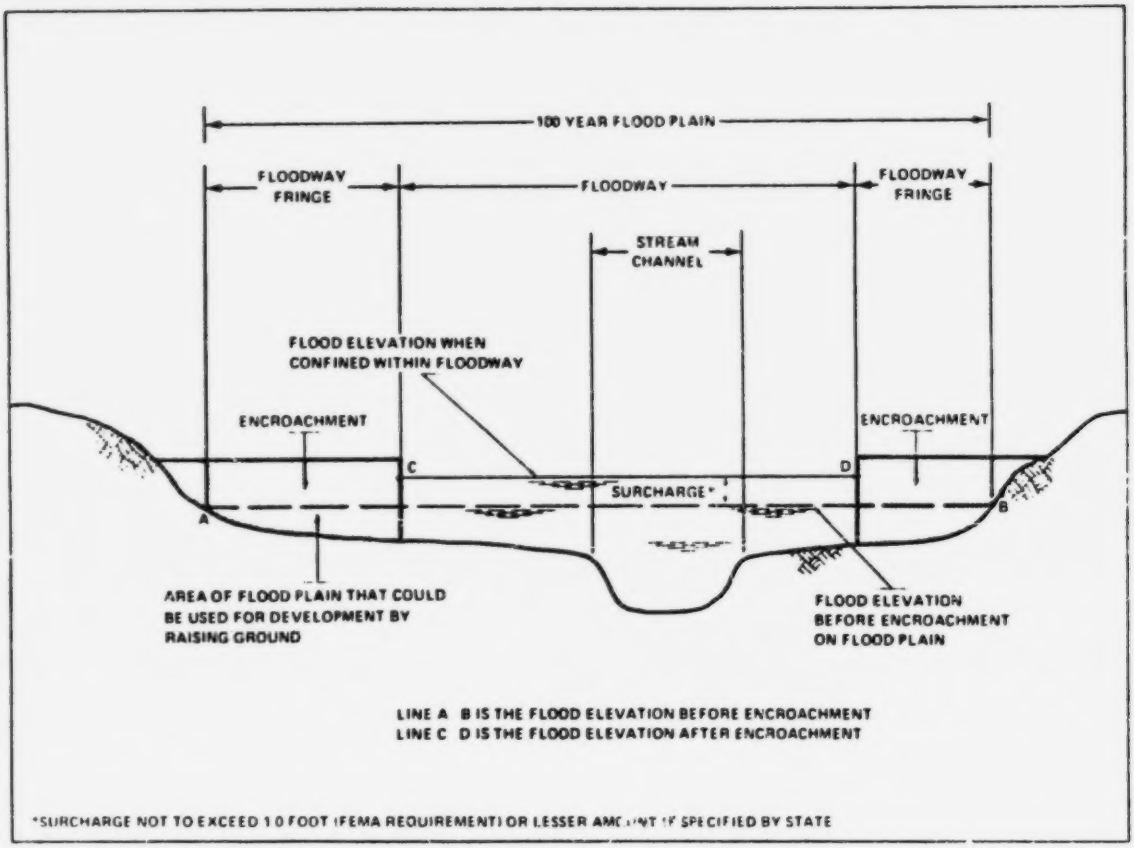
TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN CO.)

FLOOD INSURANCE ZONE DATA

FARM RIVER (EAST HAVEN RIVER)-MALONEY BROOK-TUTTLE BROOK-LONG ISLAND SOUND


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Floodway Schematic - Figure 5

The locations of the reaches determined for the flooding sources of the Town of East Haven are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

Reaches are defined as sections of floodplain that have relatively the same flood hazard. In areas where a wave height analysis was performed, reaches were determined for areas of the coastline, represented by a transect or group of transects, that have the same physical characteristics. The reaches determined for the tidal flooding source in the Town of East Haven are summarized in Table 4A.

TABLE 4A - FLOOD INSURANCE ZONE DATA

Flooding Source	Stillwater Elevation 10-Year	50-Year	100-Year	500-Year	FHF	Zone	Base Flood Elevation (Feet NGVD)*
Long Island Sound Transects 1-9	8.5	9.9	10.7	12.4	035	V7	13-16
					030	A6	11-13

*Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zones A1, A2, A4, A5, A6, and A9: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone V7: Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 4A.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of East Haven is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

In 1975, Griswold and Fuss, Inc., completed a study of the Farm River (East Haven River) for the Connecticut Department of Environmental Protection (Reference 6). The area studied was in North East Haven, from Interstate Route 95 to the corporate limits. In the 1975 study, the Interstate Route 95 bridge was viewed as a dam and the floodwaters were routed through it, thereby accounting for the floodplain storage. The result was a lowering of the 100-year flood elevation by approximately 1.5 feet when compared with the East Haven Flood Insurance Study. Above the area affected by Interstate Route 95, the profiles from both these studies converged to within one foot.

Flood Insurance Studies have been prepared for the Towns of Branford and West Haven and the City of New Haven (References 18, 19, and 20). The results of this study are in exact agreement with the results of those studies.

Because it is based on more up-to-date analyses, this study supersedes the previously printed Flood Insurance Study for the Town of East Haven (Reference 17).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, Computer Program, Project Formulation, Hydrology, Washington, D. C., 1965.

2. Dewberry & Davis, prepared for the Federal Emergency Management Agency, Tidal Flood Profiles for the Connecticut Shoreline of Long Island Sound, Fairfax, Virginia, February 1982.

3. U. S. Army Corps of Engineers, New England Division, Tidal Flood Profiles for the New England Coastline, Waltham, Massachusetts, January 1980.

4. Federal Emergency Management Agency, Flood Insurance Study, City of New London, New Haven County, Connecticut, Washington, D. C., August 19, 1985.

5. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated with Storm Surges, Washington, D. C., 1977.

6. Griswold and Fuss, Inc., for State of Connecticut Water and Related Resources, Department of Environmental Protection, Study for a Flood Protection Plan of the Farm River in East Haven, Connecticut, January 1975.

7. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 61, WSP-2 Computer Program, Washington, D. C., May 1976.

8. U. S. Army Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, Galveston, Texas, June 1975.

9. State of Connecticut, Department of Environmental Protection, Aerial Photographs, Scale 1:1,000, October 8, 1986.

10. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Intervals 10 and 20 Feet: Branford, Connecticut, 1967, Photorevised 1972; New Haven, Connecticut, 1967, Photorevised 1972; Woodmont, Connecticut, 1960, Photorevised 1971.

11. Quinn and Associates of Horsham, Pennsylvania, for East Haven Department of Public Service, Topographic Maps, Scale 1:1,200, Contour Interval 2 Feet: Town of East Haven, Connecticut, 1973.

12. The Colony Beach and Tennis Club, Topographic Maps, Scale 1:480, Contour Interval 2 Feet, undated.

13. Mingolello, Sackett, and Hayes Architects, Grading Plans, the Colony Beach and Tennis Club, Scale 1"=40', Contour Interval 2 Feet, April 17, 1989.

14. Environmental Design Associates, Profiles for Colony Beach and Tennis Club, Horizontal Scale, 1"=100', Vertical Scale 1"=5', June 27, 1989.

15. TPA Design Group, Beach Topography, Scale 1:480, June 26, 1989.

16. Town of East Haven, Connecticut, Department of Public Services, Topographic Maps, Scale 1:2,400, Contour Intervals 2 and 5 Feet: East Haven, Connecticut, April 1973.

17. Federal Emergency Management Agency, Flood Insurance Study, Town of East Haven, New Haven County, Connecticut, Washington, D. C., September 16, 1982 (Flood Insurance Rate Map date March 16, 1983.

18. Federal Emergency Management Agency, Flood Insurance Study, Town of Branford, New Haven County, Connecticut, Washington, D. C., April 18, 1983.

19. Federal Emergency Management Agency, Flood Insurance Study, Town of West Haven, New Haven County, Connecticut, Washington, D. C., April 18, 1983.

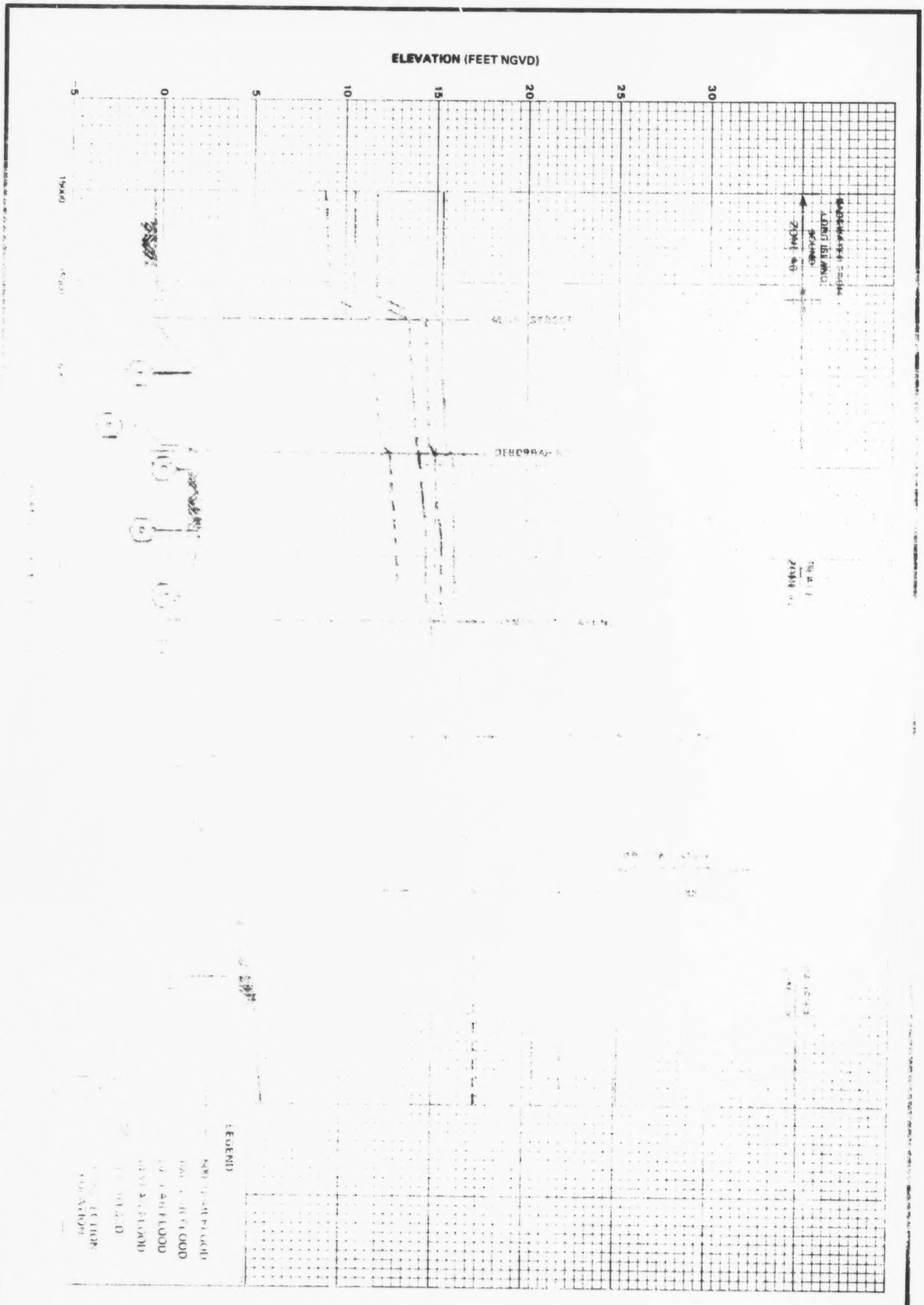
20. Federal Emergency Management Agency, Flood Insurance Study, City of New Haven, New Haven County, Connecticut, Washington, D. C., May 2, 1983.

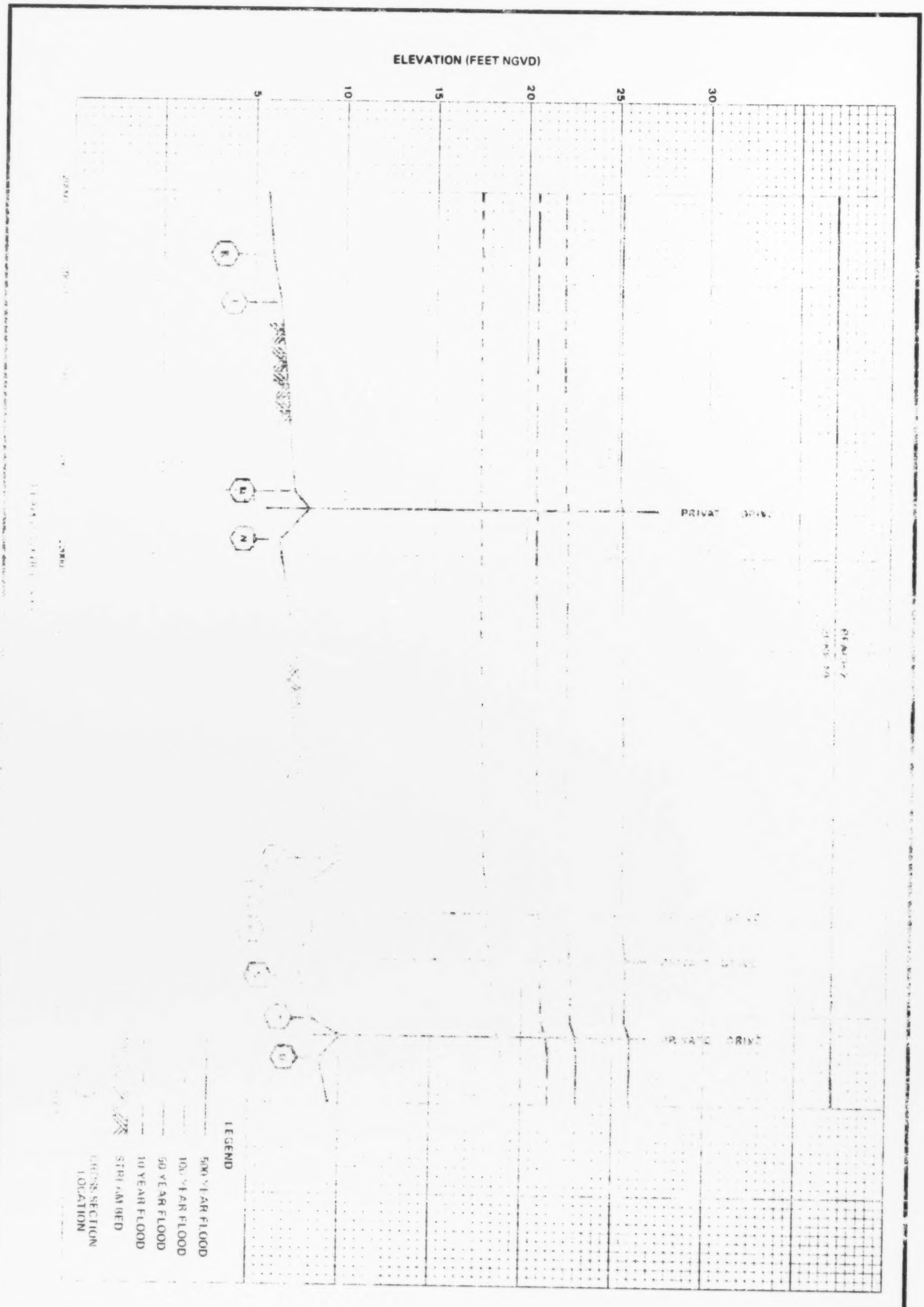
U. S. Army Corps of Engineers, New England Division, Long Island Sound Interim Memo No. COE2, Tidal Hydrology, June 1973.

Federal Emergency Management Agency, Guidelines and Specifications for Wave Elevation Determination and V Zone Mapping, July 1988.

Federal Emergency Management Agency, Users Manual for Wave Height Analysis, Washington, D. C., Revised February 1981.

Aero Graphics Corporation of Bohemia, New York, for Connecticut Department of Environmental Protection, Aerial Photographs, Scale 1:12,000, Town of East Haven, Connecticut, April 1980.


ELEVATION (FEET NGVD)
-5
0
5
10
15
20
25
30
MAIN STREET
DEBORAH
LEGEND



FEDERAL EMERGENCY MANAGEMENT AGENCY

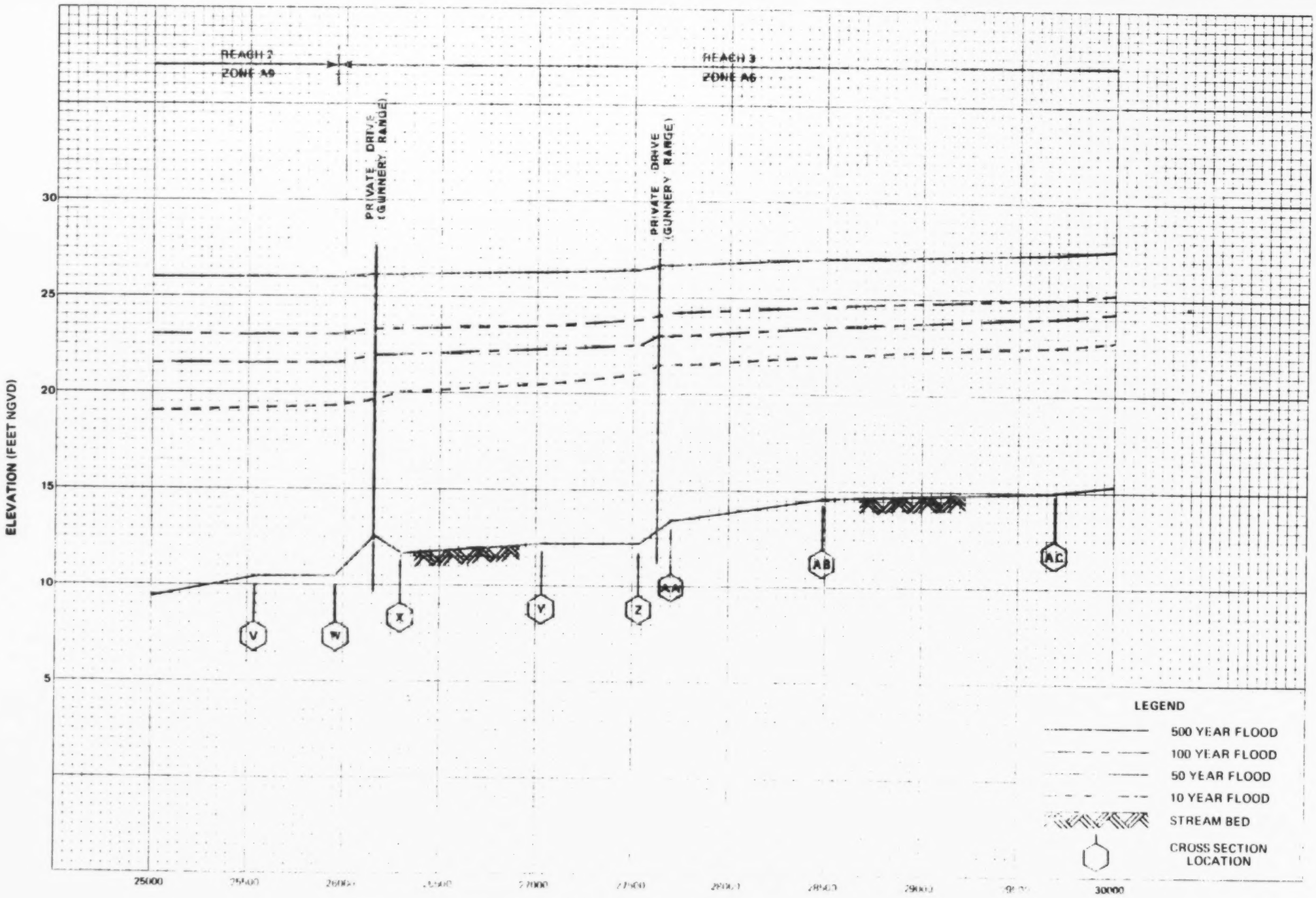
02P

TOWN OF EAST HAVEN, CT

(NEW HAVEN COUNTY)

FLOOD PROFILES

FARM RIVER (EAST HAVEN RIVER)



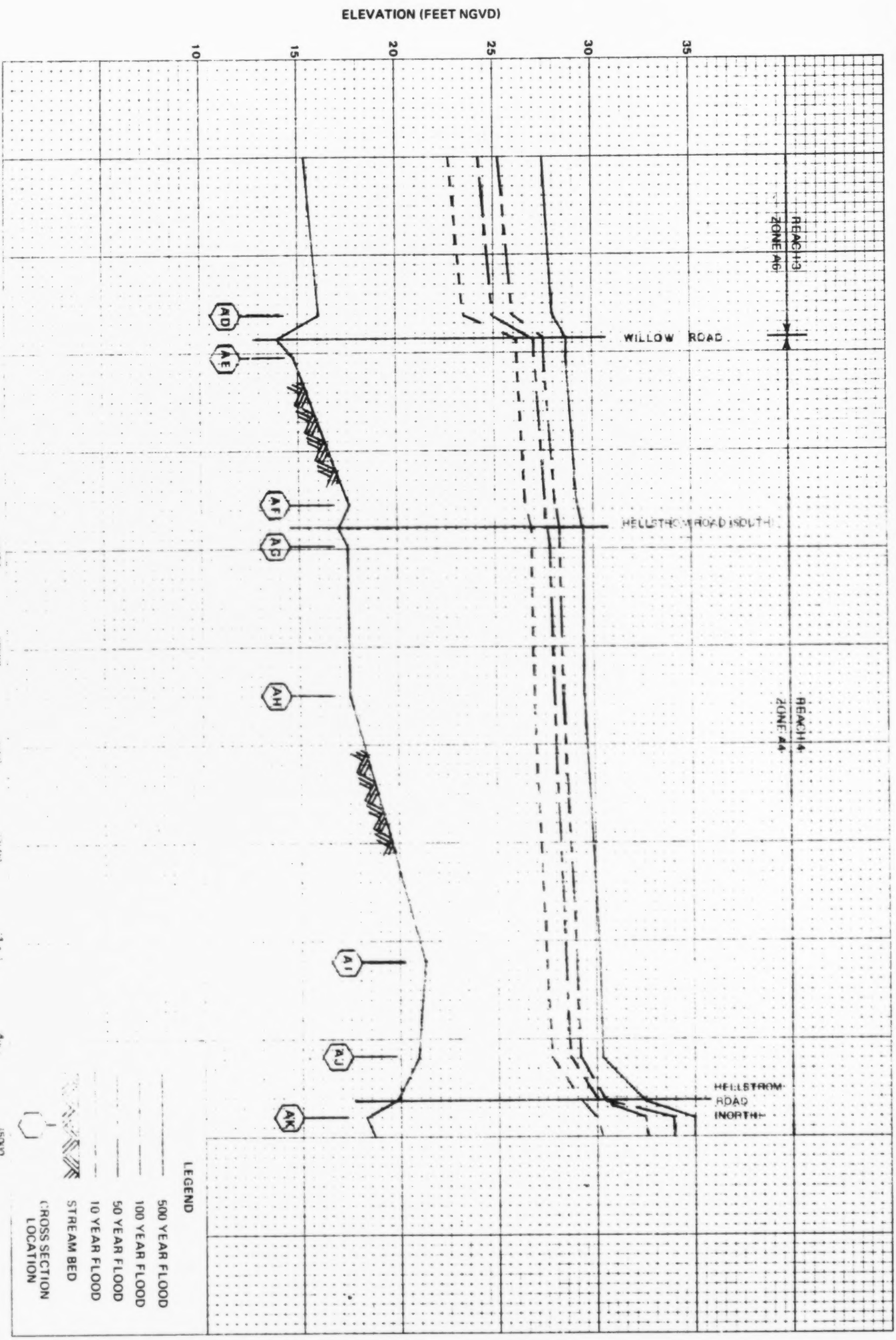
FLOOD PROFILES

FARM RIVER (EAST HAVEN RIVER)

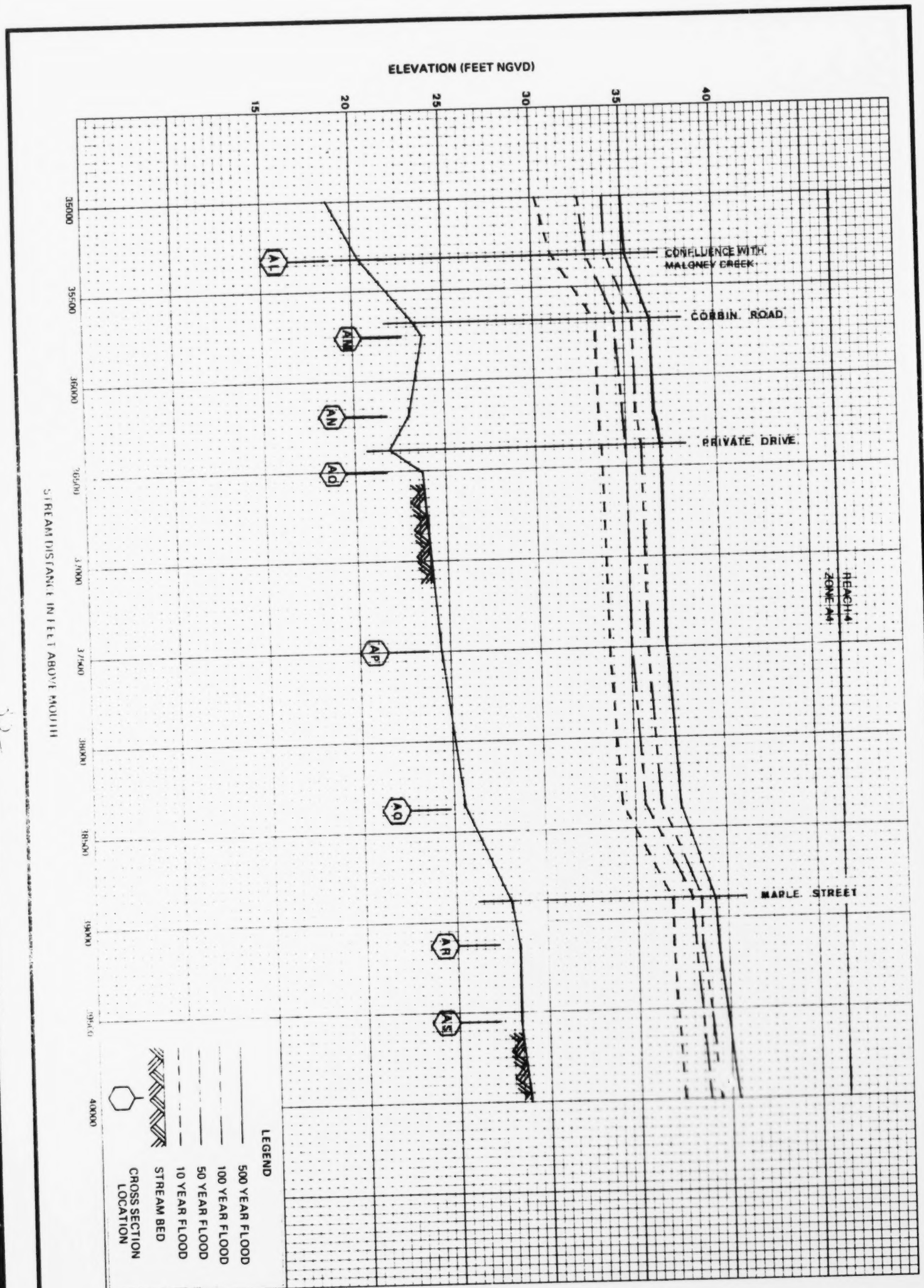
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT
(NEW HAVEN COUNTY)

03P



04P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWN OF EAST HAVEN, CT (NEW HAVEN COUNTY)	FLOOD PROFILES FARM RIVER (EAST HAVEN RIVER)



FEDERAL EMERGENCY MANAGEMENT AGENCY

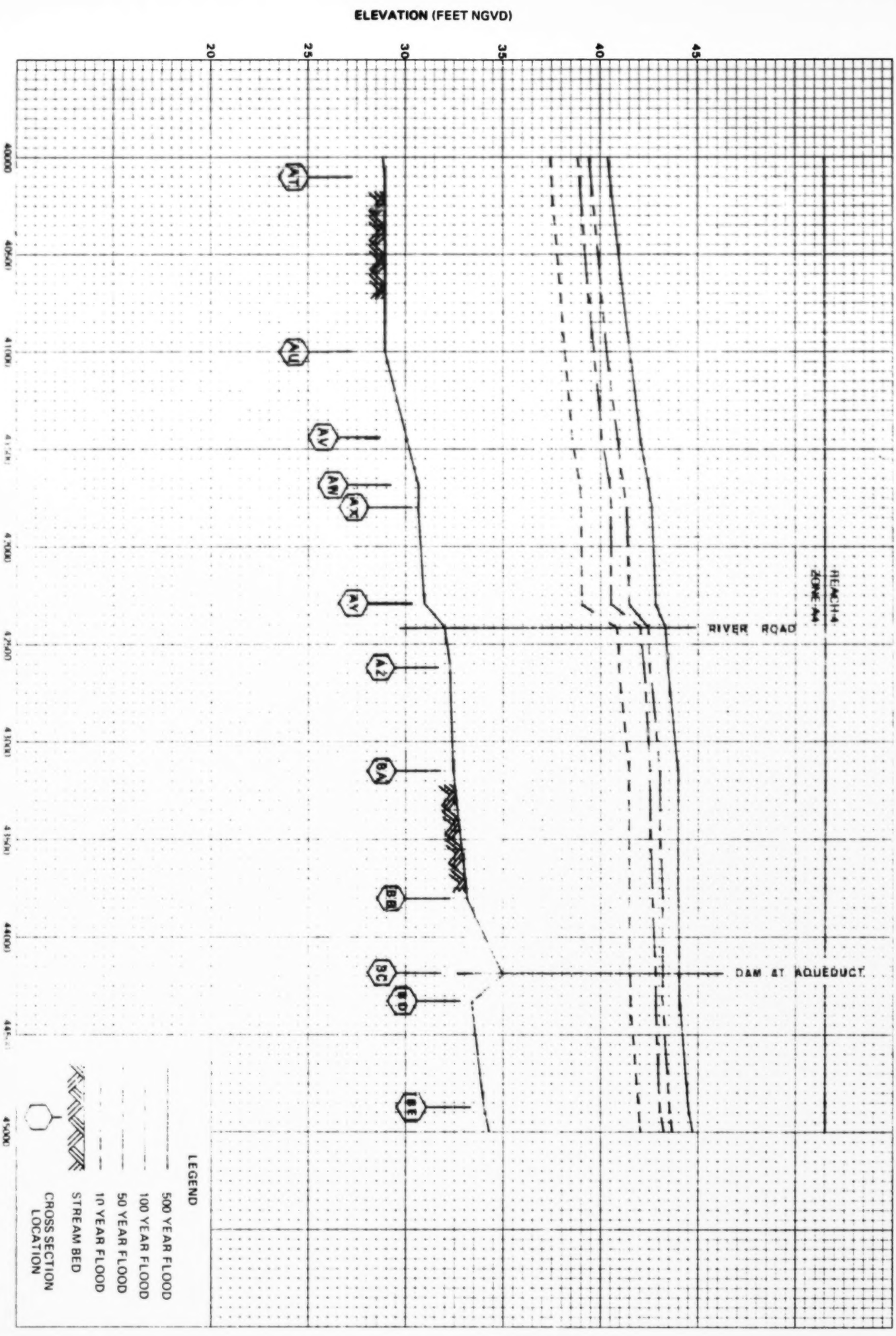
TOWN OF EAST HAVEN, CT

(NEW HAVEN COUNTY)

FLOOD PROFILES

FARM RIVER (EAST HAVEN RIVER)

05P



FEDERAL EMERGENCY MANAGEMENT AGENCY

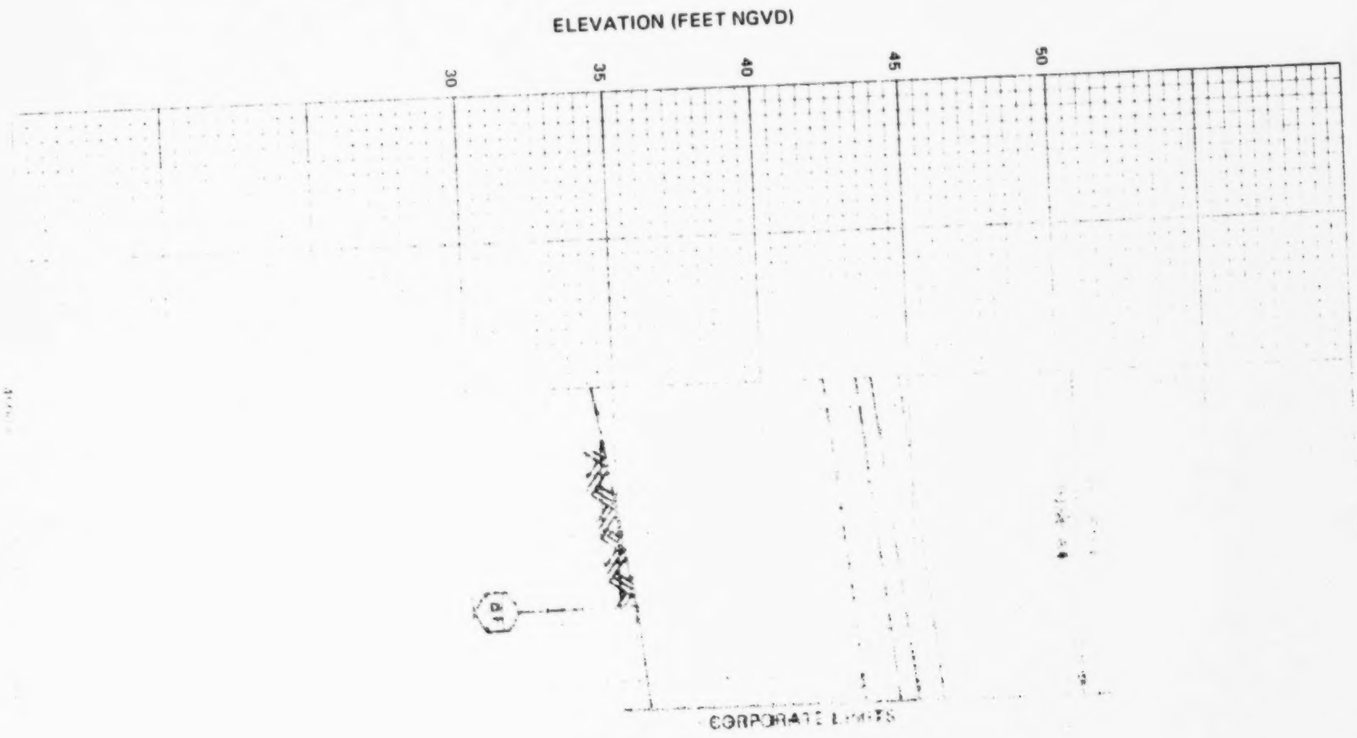
TOWN OF EAST HAVEN, CT

(NEW HAVEN COUNTY)

FLOOD PROFILES

FARM RIVER (EAST HAVEN RIVER)

06P



LEGEND

100-YEAR FLOOD

500-YEAR FLOOD

FLOODWAY

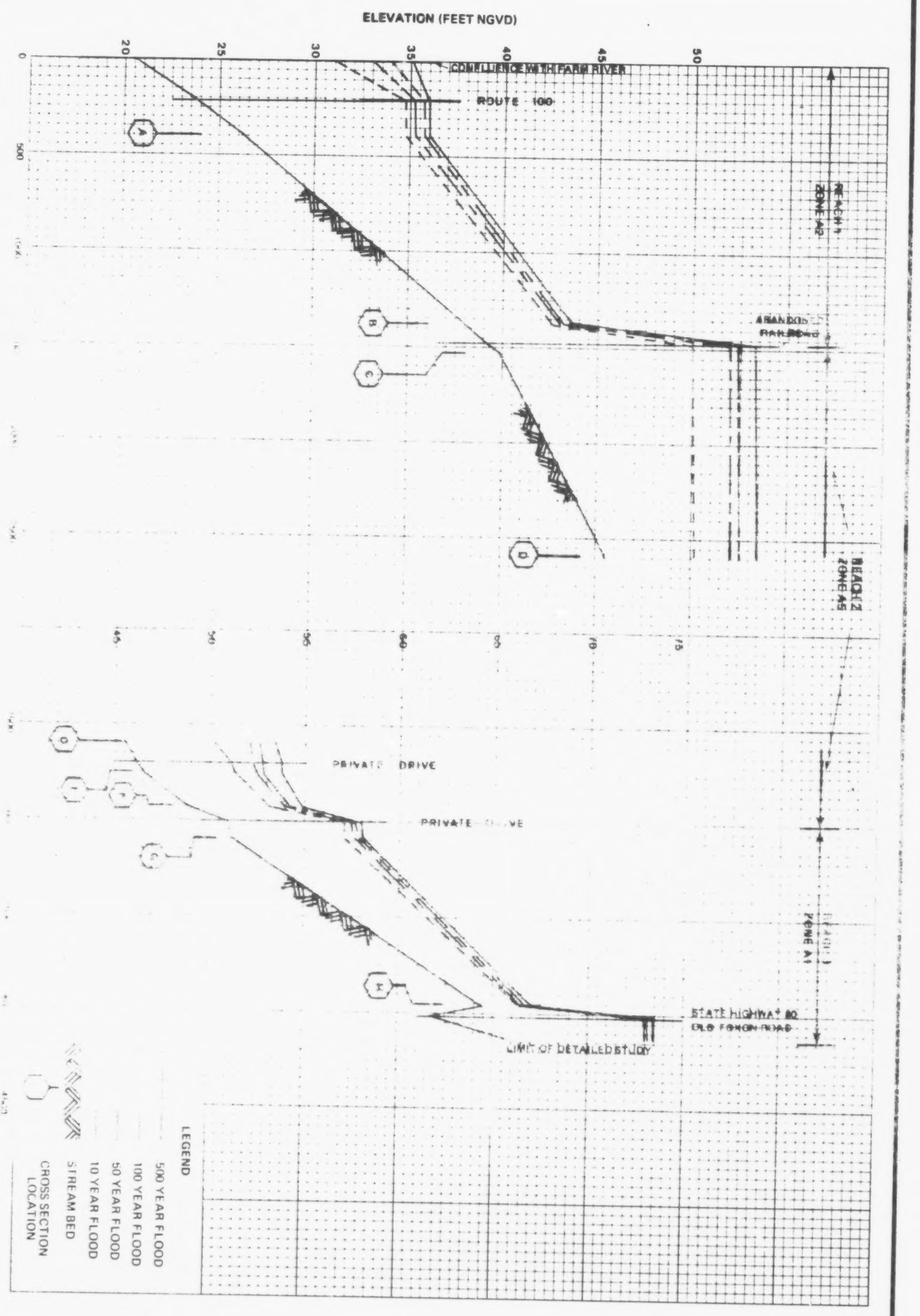
CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

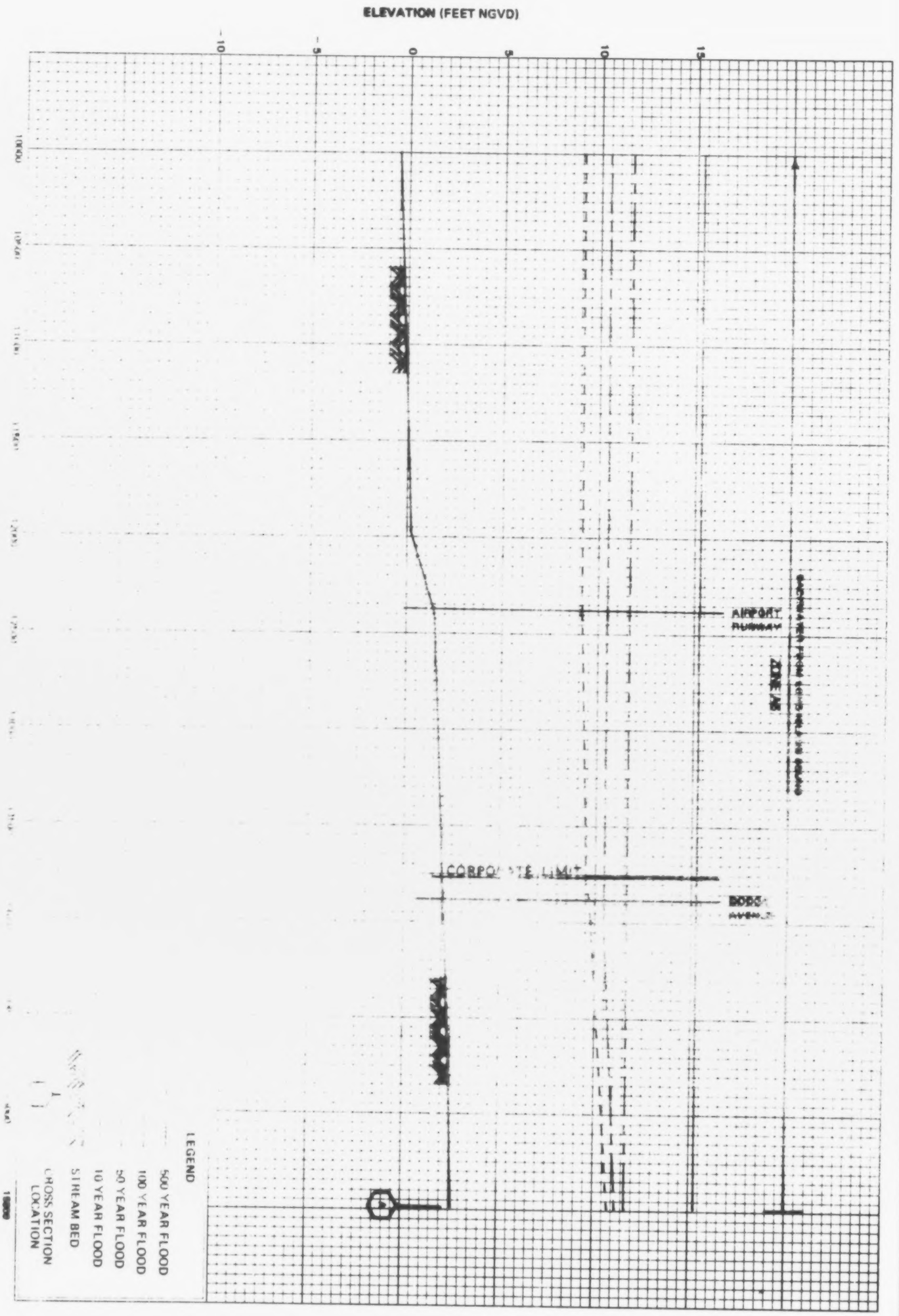
TOWN OF EAST HAVEN, CT
(NEW HAVEN COUNTY)

FLOOD PROFILES

FARM RIVER (EAST HAVEN RIVER)



08P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWN OF EAST HAVEN, CT (NEW HAVEN COUNTY)	FLOOD PROFILES MALONEY BROOK



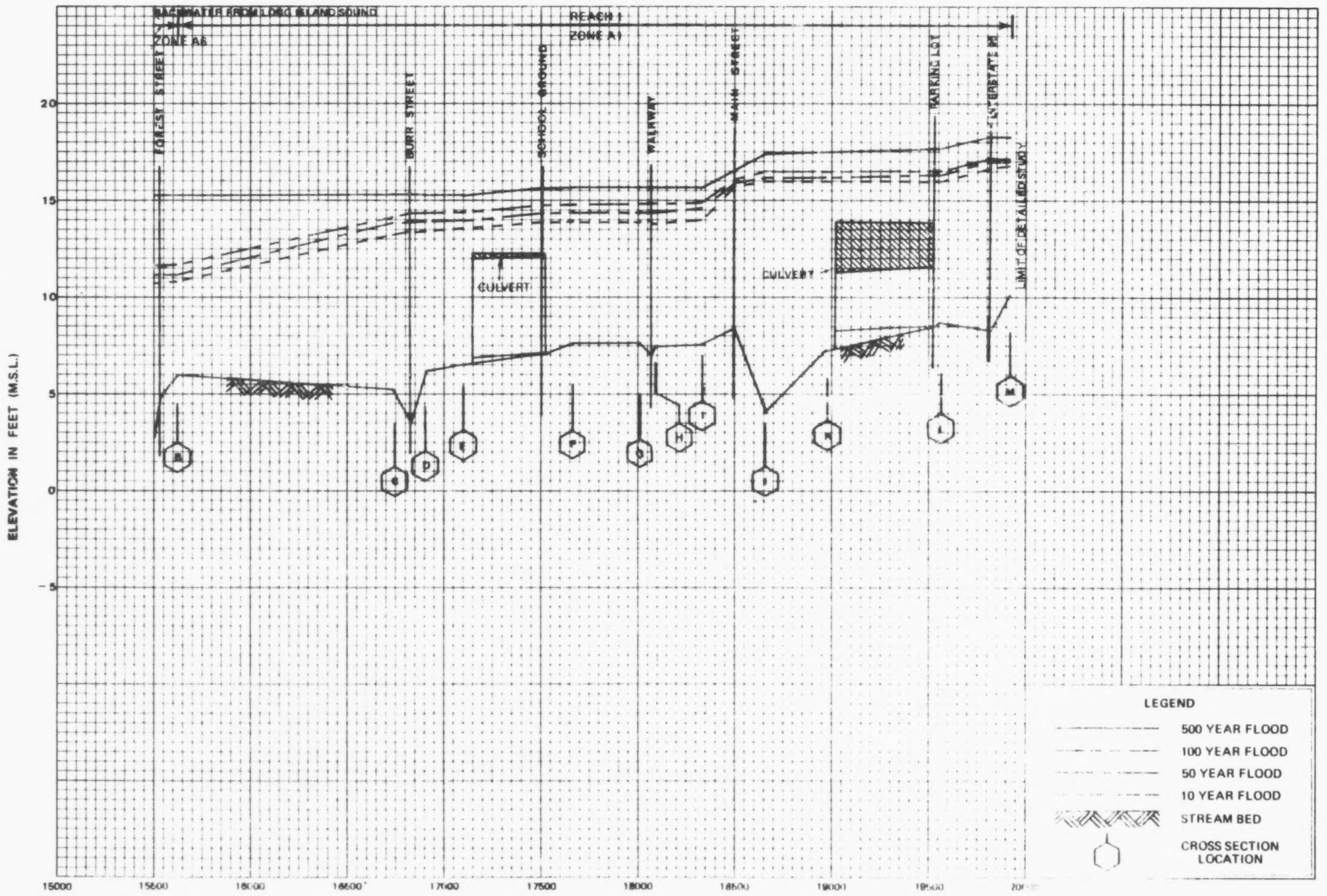
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF EAST HAVEN, CT

(NEW HAVEN COUNTY)

FLOOD PROFILES

[illegible]



FLOOD PROFILES

TUTTLE BROOK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF EAST HAVEN, CT
(NEW HAVEN COUNTY)

10P

EXHIBIT 1